



**IN THE SPECIFICATION:**

Amend paragraph [0013] as follows:

Another aspect of the invention is to provide an antimicrobial composition obtained from plant materials, plant extracts or essential oils obtained from the plant materials. In one preferred embodiment of the invention, the plant materials, plant extracts or essential oils are obtained from *Origanum vulgare* L., *Thymus vulgaris* L., *Cinnamomum zeylanicum* Nees, *Rosmarinum Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L. The antimicrobial composition typically contains a mixture of the plant materials, plant extracts or oils in amounts effective to inhibit the growth of microorganisms.

Amend paragraph [0018] as follows:

The aspects of the invention are basically attained by providing a process for inhibiting the growth of microorganisms. The process comprises the step of contacting the microorganisms or a surface containing the microorganisms with an effective amount of an antimicrobial composition. In one embodiment, the antimicrobial composition includes a mixture of plant materials comprising *Origanum vulgare* L., *Thymus vulgaris* L., *Rosmarinum Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L. In another embodiment of the invention, the composition also contains *Cinnamomum zeylanicum* Nees in an amount effective to provide an antimicrobial and stabilizing effect.

Amend paragraph [0019] as follows:

The aspects of the invention are further attained by providing a shelf stable composition comprising a substrate, and an effective amount of an antimicrobial agent to inhibit the growth of microorganisms on or in the substrate. The antimicrobial agent includes a mixture of plant extracts comprising *Origanum vulgare* L., *Thymus vulgaris* L.,

*Rosmarinum* *Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L.

In another embodiment, the antimicrobial agent also contains *Cinnamomum zeylanicum* Nees in an amount effective to stabilize the composition and inhibit the growth of microorganisms.

Amend paragraph [0020] as follows:

The aspects of the invention are also attained by providing a preservative and stabilizing composition which comprises an antimicrobial agent. The antimicrobial agent is comprised of a mixture of plant materials and extracts selected from the group consisting of *Origanum vulgare* L., *Thymus vulgaris* L., *Rosmarinum* *Rosmarinus officinalis* L., and *Lavandula officinalis* L. A carrier for the antimicrobial agent is provided. The antimicrobial agent is present in an amount effective to inhibit the growth of microorganisms. In one embodiment, the antimicrobial agent also includes a component selected from the group consisting of *Cinnamomum zeylanicum* Nees, *Hydrastis canadensis* L, olive leaf extract and mixtures thereof.

Amend paragraph [0025] as follows:

The antimicrobial agent of the invention is a mixture of botanical or plant materials and extracts containing active compounds that are combined in a manner to provide antimicrobial activity. The antimicrobial agent and compositions containing the antimicrobial agent can contain the whole plant, extracts of the plant and mixtures thereof. In preferred embodiments, the botanical components are extracts, oils or fractions containing the active components. The antimicrobial agent in one preferred embodiment of the invention is a mixture of botanical extracts and oils of *Origanum vulgare* L., *Thymus vulgaris* L., *Cinnamomum zeylanicum* Nees, *Rosmarinum* *Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L. With the exception of *Hydrastis canadensis* L.,

each of the botanical materials are present in an amount of about 5 wt% to about 40 wt% based on the total weight of the antimicrobial agent. Due primarily to its limited solubility, *Hydrastis canadensis* L. is included in amounts of 0.1 wt% or less, and typically 0.01 wt% or less. The botanical materials are preferably combined in synergistic amounts to attain antimicrobial activity for one or more target microorganisms to be inhibited.

Amend paragraph [0026] as follows:

In preferred embodiments of the invention, extracts of the botanical materials are mixed together in proportions to provide the desired antimicrobial activity. The ratio of the components can also be adjusted to increase the antimicrobial activity or selectivity for a target microorganism. In various embodiments of the invention, the antibacterial composition contains about 20 to 40 wt% *Origanum vulgare* L., about 20 to 40 wt% *Thymus vulgaris* L., about 10 to 20 wt% *Cinnamomum zeylanicum* Nees, about 10 to 30 wt% *Rosmarinum Rosmarinus officinalis* L. and about 5 to 15 wt% *Lavandula officinalis* L. In one preferred embodiment, the antimicrobial composition also contains about 0.001 to about 0.01 wt% and typically about 0.001 wt% to 0.003 wt% of *Hydrastis canadensis* L. A particularly suitable antimicrobial composition comprises about 30 wt% *Origanum vulgare* L., about 30 wt% *Thymus vulgaris* L., about 10 wt% *Cinnamomum zeylanicum* Nees, about 20 wt% *Rosmarinum Rosmarinus officinalis* L., about 0.002 wt% *Hydrastis canadensis* L., and the balance (about 10 wt%) *Lavandula officinalis* L.

Amend paragraph [0027] as follows:

In one preferred embodiment, the antimicrobial agent includes about 20 wt% to about 40 wt% *Origanum vulgare* L., about 20 wt% to about 40 wt% *Thymus vulgaris* L., about 10 wt% to about 30 wt% *Rosmarinum Rosmarinus officinalis* L., and about 5 wt% to about 15

wt% *Lavandula officinalis* L.. The antimicrobial agent can also contain about 0.001 wt% to about 0.01 wt% *Hydrastis canadensis* L., about 0.001 wt% to about 0.005 wt% olive leaf extract, and mixtures thereof. In further embodiments, the antimicrobial agent can include an effective amount of the cinnamon bark extract to inhibit the growth of *S. typhimurium* and *P. aeruginosa*.

Amend paragraph [0035] as follows:

The plant materials, oils and extracts have been found to have a synergistic effect when combined to provide effective antimicrobial activity that is not found in the plant materials individually. The plant materials have been found to contain various compounds that when combined in the mixture of botanical materials exhibit antimicrobial properties. For example, *Origanum vulgare* L., and *Thymus vulgaris* L. contain carvacrol and thymol. *Cinnamomum zeylanicum* Nees contains primarily cinnamaldehyde and eugenol. *Rosmarinum Rosmarinus officinalis* L. contains 1,8-cineole, camphor,  $\alpha$ -pinene and small amounts of rosmarinic acid. *Lavandula officinalis* L. contain linalyl acetate and linalol. *Hydrastis canadensis* L contain berberine and hydrastine alkaloids. In one embodiment of the invention, the antimicrobial agent is a mixture of the botanical materials, extracts or essential oils to provide antimicrobial amounts of carvacrol, thymol, cinnamaldehyde, eugenol, cineole, camphor,  $\alpha$ -pinene, rosmarinic acid, linalol, linalyl acetate, berberine and hydrastine where the components are provided in an amount to obtain an antimicrobial effect.

Please amend paragraph [0038] as follows:

In one embodiment, the antimicrobial composition comprises about 33.3 wt% *Origanum vulgare* L., about 33.3 wt% *Thymus vulgaris* L., about 22.3 wt% *Rosmarinum Rosmarinus officinalis* L., about 0.002 wt% *Hydrastis canadensis* L., and the balance (about

10 wt%) *Lavandula officinalis* L. In a further embodiment, the composition also contains about 0.001 wt% olive leaf extract.

Please amend paragraph [0045] as follows:

The process of the invention inhibits the growth of microorganisms by contacting the microorganisms with an effective amount of the antimicrobial agent or by applying the antimicrobial agent to a base material or substrate where the microorganisms come in contact. The base material can be a food product or a solid surface. In one embodiment, the base material is capable of supporting the growth of microorganisms. The effective amount of the antimicrobial agent can vary depending on the particular microorganism to be inhibited and expected concentration of the microorganisms to be encountered. The antimicrobial agent is typically used to provide a minimum inhibitory concentration (MIC) amount. In one preferred embodiment, the antimicrobial agent is obtained from a mixture of plant materials including *Origanum vulgare* L., *Thymus vulgaris* L., *Cinnamomum zeylanicum* Nees, *Rosmarinum Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L. In one embodiment, the plant materials are used in substantially equal amounts. The antimicrobial agent containing the mixture of the plant materials have an MIC about 1.5  $\mu$ l/ml or less for gram-negative and gram-positive bacteria. The antimicrobial agent has an MIC of 1.5  $\mu$ l/ml or less for *E. coli*, an MIC of 0.75  $\mu$ l/ml or less for *Klebsiella pneumoniae*, and an MIC of 0.5  $\mu$ l/ml for *Mycobacterium*.

Please amend paragraph [0050] as follows:

It has been observed that the combination of botanical materials or extracts of *Origanum vulgare* L., *Thymus vulgaris* L., *Cinnamomum zeylanicum* Nees, *Rosmarinum Rosmarinus officinalis* L., *Lavandula officinalis* L., and *Hydrastis canadensis* L. have a lower

MIC than the conventional preservatives such as phenoxyethanol, phenylethyl alcohol, and a mixture of methylparabens/propylparabens in a ratio of 5:4. The antimicrobial agent of the invention has been found to have a MIC of 3.0  $\mu$ l/ml for gram-positive *Staphylococcus aureus*, gram-negative *Escherichia coli*, *Salmonella typhimurium*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, acid-fast bacterium *Mycobacterium smegmatis*, and *M. tuberculosis*, the yeast *Candida albicans*, and the filamentous mold *Aspergillus niger*. The following non-limiting examples demonstrate the effectiveness of the antimicrobial agent and compositions containing the antimicrobial agent.

Please amend paragraph [0051] as follows:

An antimicrobial agent was prepared from a mixture of botanical extracts containing 30 wt% *Origanum vulgare* L., 30 wt% *Thymus vulgaris* L., 10 wt% *Cinnamomum zeylanicum* Nees, 20 wt% *Rosmarinum* *Rosmarinus officinalis* L., about 9.998 wt% *Lavandula officinalis* L., and 0.002 wt% *Hydrastis canadensis* L. The leaves from the plant materials were macerated and the various compounds and oils extracted. The resulting extracts were combined to form the antimicrobial agent.

Please amend paragraph [0073] as follows:

An antimicrobial agent was prepared from a mixture containing 0.002 *Hydrastis canadensis* L., 0.001 wt% *Olea europaea*, 33.3 wt% *Origanum vulgare* L. extract, 33.3 wt% *Thymus vulgaris* L. extract, 22.2 wt% *Rosmarinum* *Rosmarinus officinalis* L. extract, and the balance *Lavandula officinalis* L. extract (about 8.99 wt%).